REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 11 to clarify that each micro pillar has a bottom end at the matrix surface and a top end opposite the bottom end, and that a shape of each of the micro pillars is such that the top end of each micro pillar has a smaller sectional area than that of the bottom end. Note, for example, Figs. 2 and 3 of Applicants' original disclosure, together with the description in connection therewith on pages 13 and 14 thereof. Note also, for example, claims 28, 30 and 31; it is respectfully submitted that by elongating the organic polymer when the mold separated therefrom, the structure formed would have micro-pillars such that the top end of each micro pillar has a smaller sectional area than a bottom end thereof.

In addition, Applicants are adding new claims 35 and 36 to the application. Claims 35 and 36, each dependent on claim 11, respectively recites that the group of micro pillars is formed integrally with the matrix surface; and recites that the organic polymer of the group of micro pillars is the same organic polymer as that of the matrix surface, with the group of micro pillars being formed integrally with the matrix surface.

The concurrently filed RCE Transmittal is noted. It is respectfully submitted that the present amendments constitute the necessary Submission supporting this RCE Transmittal; and that in view of the filing of this RCE Transmittal, entry of the present amendments is clearly proper as a matter of right, notwithstanding the Finality of the Office Action dated October 20, 2009.

Applicants respectfully submit that all of the claims being considered on the merits in the above-identified application patentably distinguish over the teachings of

the references applied by the Examiner in rejecting claims in the Office Action dated October 20, 2009, that is, the teachings of the U.S. patent documents to Austin, et al., Patent No. 6,632,652 (Austin '652), to Austin, et al., Patent No. 5,427,663 (Austin '663), to Wang, et al., Patent Application Publication No. 2003/0119922, to Noca, et al., Patent Application Publication No. 2003/0052006, and to Agrawal, et al., Patent No. 7,159,872, under the provisions of 35 USC 103.

It is respectfully submitted that the teachings of these references as applied by the Examiner would have neither disclosed nor would have suggested such a micro biochip as in the present claims, including the group of micro pillars, the micro pillars being provided in a flow path for feeding a sample, with the shape of each of the micro pillars being such that the top end of the micro pillar has a smaller sectional area than that of the bottom end, and with equivalent diameters of the micro pillar group being 10 nm through 100 μm with a height of 0.5 μm through 500 μm, and with an aspect ratio of a micro pillar of the micro pillar group being 4 or more. See claim 11. Note, also, each of claims 33 and 34, each reciting that columnar micro pillars, of the group of columnar micro pillars, have an aspect ratio of 4 or more.

By providing the micro pillars such that each micro pillar has a top end with a smaller sectional area than that of the bottom end, as in claim 11, the micro pillars of the micro biochip can easily and effectively be manufactured, e.g., by pressing a mold, having pits, against a material of the micro pillar such that the material is pressed into the pits, and separating the mold therefrom, thereby to elongate the columnar micro pillars from a matrix surface. Note, for example, claims 28, 30 and 31. Thus, the micro biochip according to the present invention can be provided with accurate and precise dimensions, including, inter alia, equivalent diameter and

height, and an aspect ratio that is 4 or more.

In particular, and as will be discussed in more detail infra, it is respectfully submitted that the teachings of the prior art applied by the Examiner in connection with, e.g., claim 11 would not have taught such aspect ratio of the micro pillars being 4 or more as in the present claims, and advantages achieved thereby.

The Examiner relies on the teachings of Wang, et al., for such aspect ratio. As Wang, et al. discloses a catalyst having a layer of carbon nanotubes, the teachings of this reference would not have been properly combinable with teachings of other applied references, e.g., Austin '652 and Austin '663 And, in any event, Wang, et al. discloses aspect ratios of carbon nanotubes, not of micro pillars; and it is respectfully submitted that the teachings of this reference of Wang, et al., alone or in combination with the teachings of the other applied references, would have neither disclosed nor would have suggested the aspect ratio of micro pillars, as in the present claims, and advantages thereof.

To emphasize, it is respectfully submitted that the teachings of Wang, et al., describing aspect ratio of carbon nanotube catalysts, either alone or in combination with the teachings of the other applied references, would have neither disclosed nor would have suggested an aspect ratio of micro pillars as in the present claims, and advantages thereof.

As will be seen in the discussion, infra, as to the teachings of Wang, et al., it is respectfully submitted that this reference does not disclose, nor would have suggested, an array which has microstructures arranged in a regulated order; does not disclose, nor would have suggested, molded nanostructures integrally extending from a substrate; does not disclose, nor would have suggested, an aspect ratio of micro pillars integrally extending from a matrix surface; and does not disclose, nor

would have suggested, an aspect ratio of the micro pillars, integrally extending from the matrix surface. It is respectfully submitted that Wang, et al. only discloses aspect ratios of carbon nanotubes used for catalysts which are manufactured by a pyrolysis method of a carbon source, to produce separated and randomly scattered carbon nanotubes. Such carbon nanotubes, which are separated and scattered randomly, would have neither disclosed nor would have suggested the micro pillars having the aspect ratio as in the present claims.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested the micro biochip as in the present claims, having the recited aspect ratio, and wherein such micro biochip was formed by the process of claim 27 (see claim 33), or by the process of claim 16 (see claim 34); and/or wherein the group of micro pillars are formed integrally with the matrix surface (see claim 35); and/or wherein the organic polymer of the micro pillars and of the matrix surface is the same, the micro pillars being formed integrally with the matrix surface (see claim 36).

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a micro biochip as in the present claims, having features as discussed previously in connection with claim 11, and further including, inter alia, features as in other claims dependent on claim 11, such as (but not limited to) wherein the organic polymer is modified on the surface of the micro pillars (see claim 12); and/or wherein the organic polymer contains at least one of antigen, sugar chain and bases (see claim 13); and/or wherein the micro pillar group is a group of micro pillars formed by pressing a mold, having pits, against the material such that the material is pressed into the pits, and separating the mold therefrom, thereby to elongate the columnar

micro pillars from the matrix surface (see claim 28), particularly wherein the organic polymer is modified on the surface of the micro pillars (see claim 29); and/or wherein the material of the group of micro pillars includes such an organic polymer that elongates when the mold, having the material of the group of micro pillars therein, is separated therefrom (see claims 30 and 31).

The invention being considered on the merits in the above-identified application is directed to a micro biochip, being equipped with micro pillar groups.

As described on pages 1-3 of Applicants' specification, various types of nano-pillar structures have been proposed, formed by various techniques. For example, a nano-silicon pillar group using a metallic cluster such as iron, gold and silver as a self-forming nucleus of a plasma etching mask has been proposed. Another technique forms resin-made micro pillars, in which the surface of a silicon substrate is coated with a polymethyl methacrylate film; a mask of a silicon substrate is placed on the film through a spacer; and then heating is performed, in order to form micro pillars on the polymethyl methacrylate film.

However, previously proposed structures involved certain problems. For example, the nano-pillars formed as described in various of the foregoing proposals are restricted to inorganic materials, and require a dry etching method. Moreover, in forming the polymethyl methacrylate micro pillars, it has been difficult to control the position, the diameter and height of the micro pillars freely.

Against this background, Applicants provide structure that can easily and effectively be provided, and which can provide accurate and precise micro pillars made of plastic material and incorporates such micro pillars in a micro biochip to ensure highly sensitive analysis using such micro biochip. Applicants have found that by forming the micro pillars of thermoplastic polymer material, the micro pillars

being provided in a flow path (for feeding a sample), the micro pillars having a larger diameter at the base thereof than at the top thereof (being tapered upwardly), the micro pillars having specified dimensions including an aspect ratio of at least 4, objectives of the present invention are achieved. That is, with the specified structure including aspect ratio of the micro pillars, highly sensitive analysis can be achieved.

In addition, the micro biochip can act as a molecular filter, as described in the last full paragraph on page 31, and the paragraph bridging pages 31 and 32, of Applicants' specification.

Moreover, the micro pillars are made of organic polymer material, thus forming a structure which is relatively inexpensive and which can be formed by an easy and relatively inexpensive method.

Austin '652 discloses an apparatus for sorting microstructures in a fluid medium, the apparatus including a substrate having a floor bound on opposite sides by first and second side walls, the floor and the first and second side walls defining a receptacle; means being positioned within the receptacle for showing the rate of migration of microstructures within the receptacle; and a cover that seals the receptacle and contacts the ends of the means opposite from the floor of the receptacle, being selectively separable therefrom. This patent goes on to disclose that one of the cover or the substrate is comprised of an elastomer, and the other may be comprised of silicon, quartz, sapphire or even an elastomer. See column 7, lines 38-49. Note also Fig. 7 and descriptions in connection therewith from column 9, line 46, through column 10, line 4, disclosing sorting apparatus 80 comprised of an elongated substrate 82 having a correspondingly elongated receptacle 24 located on a side thereof, and an array 86 of obstacles taking the form of bunkers 62 of the type illustrated in Fig. 5, the sorting apparatus being provided

with an elastomeric cover 88 that engages tops 66 of each bunker in array 86.

It is respectfully submitted that Austin '652 would have neither disclosed nor would have suggested such micro biochip as in the present claims, including the group of micro pillars, with shape of the micro pillars as in the present claims, and with equivalent diameter of the micro pillar group being 10 nm through 100μm with a height of 0.5 μm through 500 μm, and an aspect ratio of a micro pillar of the micro pillar group being 4 or more.

It is respectfully submitted that the teachings of the other references applied by the Examiner would not have rectified the deficiencies of Austin '652, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Austin '663 discloses apparatus and methods for fractionating microstructures such as free cells, viruses, macro molecules, or minute particles, that is, sorting apparatus, the sorting apparatus including a substrate having a shallow receptacle located on a side thereof, the receptacle having first and second ends and a floor bounded on opposite sides by a pair of upstanding opposed side walls extending between the first and second ends of the receptacle, with migration of the microstructures from the first end of the receptacle to the second end of the receptacle defining a migration direction of the receptacle, height of the side walls defining a depth of the receptacle, and this depth being commensurate with the size of the microstructures in the fluid medium. This patent discloses that the array further comprises sifting means positioned within the receptacle intermediate the first and second ends traversing the migration direction, the sifting means being, for example, an array of obstacles provided upstanding from the floor of the receptacle, with the apparatus further including ceiling means positioned over the sifting means

for covering the receptacle and for causing migration of the microstructures in essentially a single layer through the sifting means exclusively. See column 5, lines 21-67 of this patent.

As with Austin '652, Austin '663 does not disclose, nor would have suggested, features of the present invention including, inter alia, dimensions of the micro pillars including the aspect ratio of 4 or more, and advantages achieved thereby.

Wang, et al. discloses catalysts containing carbon nanotubes, methods of making catalysts containing carbon nanotubes on porous substrates, systems employing such catalysts and reactions using such catalysts. The catalyst includes a support material having through-porosity, a layer comprising carbon nanotubes on the support material, and a surface-exposed catalytically-active composition. Note paragraphs [0001], [0008] and [0009] on the first page of this patent document. This patent document goes on to describe, in paragraphs [0043] and [0044] on page 3 thereof, that in some embodiments where through-porosity is not necessary, the support can be a thin membrane of anodized aluminum or other macroporous membrane that is optionally treated with a surfactant template composition such that mesoporous silica substantially fills the macropores, with carbon nanotubes being applied to form a membrane that can be used, for example, as a molecular sieve, an adsorbent, or treated with an ion exchange medium; and that the carbon nanotubes may have a length to width aspect ratio of at least 3, more preferably at least 10, the nanotubes preferably having a length of at least 1 μm, more preferably 5-200 μm, and preferably have a width of 3-100 nm. Note also paragraph [0046] on page 4 of Wang, et al., describing that by "catalyst composition" this patent document is directed to a composition of matter that will catalyze a chemical reaction, preferred embodiments including a catalyst composition that is exposed on at least one

surface.

Initially, it is respectfully submitted that the teachings of Wang, et al. would not have been properly combinable with the teachings of the other applied references, including Austin '663 and Austin '652. Thus, note that Wang, et al. is concerned with a catalyst material, while each of the Austin references is directed to sorting/analyzing apparatus. Wang, et al. discloses a catalyst on nanotube materials, the nanotubes being individual and separate. It is respectfully submitted that one of ordinary skill in the art concerned with in each of the Austin references, would not have looked to the teachings of Wang, et al. In other words, these references are directed to non-analogous arts.

Furthermore, problems addressed by the present invention, of providing a micro biochip, and problems addressed in, for example, the Austin '652 and '663 references, of providing sorting microstructures, on the one hand; and problems addressed by Wang, et al., that is, in providing catalyst materials on carbon nanotubes, are noted. In view of the different problems involved, it is respectfully submitted that one of ordinary skill in the art involved with in the applied references, or in looking to solve problems addressed by the present invention, would not have looked to the teachings of Wang, et al.

Thus, it is respectfully submitted that absent guidance provided by hindsight use of Applicants' original disclosure, with respect to the aspect ratio described therein, one of ordinary skill in the art concerned with in the Austin references would not have looked to the aspect ratio in Wang, et al. Of course, such hindsight use of Applicants' disclosure is clearly improper under the guidelines of 35 USC 103.

Furthermore, it is respectfully submitted that the Examiner has provided no proper reason for combining the teachings of Wang, et al., with the teachings of the

two Austin references. Absent such proper reason for combining teachings of references, clearly such combination of teachings is improper under the guidelines of 35 USC 103.

In the Office Action dated October 20, 2009, the Examiner has not addressed Applicants' arguments that the teachings of Wang, et al. would not have been properly combinable with the teachings of the two Austin references. Upon proper consideration of Applicants' arguments, it is respectfully submitted that Applicants have clearly established that the teachings of Wang, et al. would not have been properly combinable with the teachings of the two Austin references, absent hindsight use of Applicants' disclosure, which hindsight use is clearly improper under the requirements of 35 USC 103.

In the first full paragraph on page 4 of the Office Action dated October 20, 2009, the contention by the Examiner that it would have been obviousness to use micro structures having an aspect ratio greater than 4 to separate biomolecules since an array having such a ratio is suitable for separating biomolecules, is noted. The Examiner has pointed to no disclosure in Wang, et al., describing that micro structures having an aspect ratio greater than 4 is suitable for separating biomolecules. It is again emphasized that Wang, et al. is directed to catalysts. It is respectfully submitted that only Applicants' disclosure provides a teaching of micro pillars having an aspect ratio of 4 or more, for a micro biochip. As indicated previously, clearly such disclosure of Applicants cannot be used as a reason for combining reference teachings, in a rejection under 35 USC 103.

The additional contention by the Examiner in the last two lines of the first paragraph on page 4 of the Office Action dated October 20, 2009, that if the micro structures had an aspect ratio of at least 4, the diameter of the micro structures of

the "modified [Austin, et al.] sieve would fall within the claimed range", is noted. The Examiner has not indicated which "modified" Austin, et al. sieve is being referred to in the last two lines of the first full paragraph on page 4 of the Office Action dated October 20, 2009. In any event, if the teachings of Wang, et al. were utilized for a disclosure of an aspect ratio greater than 4, such disclosure, by itself and/or together with the teachings of the two Austin, et al. references, would have neither taught nor would have suggested other features of the present invention, including equivalent diameter of the micro pillars, and advantages achieved by the present invention utilizing a micro biochip with micro pillars having dimensions as in the present claims; and/or other features of the present invention as discussed previously, including the integral nature of the micro pillars from the matrix surface as in various of the present claims.

In this regard, it is emphasized that Wang, et al. discloses individual and separate carbon nanotubes, which, even in light of the teachings of the two Austin, et al. references, would have taught away from features of the present invention including the micro pillars of a material including an organic polymer (it again being emphasized that Wang, et al. disclosed carbon nanotubes), or such micro pillars being formed integrally with the matrix surface and/or made of the same organic polymer as that of the matrix surface.

Concerning claims 28-31, 33 and 34, Agrawal, et al., as applied by the Examiner, discloses preparation of substrates having a high surface area for use as a micro array device, including a plurality of microstructures that may comprise, e.g., a pillar, a cone, a wall, a micro-rod, a tube, a channel or a combination thereof. See column 5, lines 12-22. Note also column 6, line 60, through column 7, line 3, of Agrawal, et al., disclosing that formation of the substrate having a high surface area

can include embossing a coating material. Note also, for example, the paragraph bridging columns 4 and 5 of this patent.

Even assuming, arguendo, that the teachings of Agrawal, et al. as applied by the Examiner were properly combinable with the teachings of the other references as applied therewith, such combined teachings would have neither disclosed nor would have suggested such micro biochip as in the present claims, having the group of micro pillars, and wherein an aspect ratio of micro pillars is 4 or more, particularly with equivalent diameter and height of micro pillars as in the present claims.

Concerning claims 12, 13, 29 and 30, Noca, et al. discloses a self-assembled nano-array molecular sieve for the separation of molecules, the apparatus being described most generally in paragraphs [0019] and [0020] on pages 2 and 3 of this patent document. This patent document discloses that, in one embodiment, the self-assembled nano-array sieve includes a substrate having a periodic array of features such that in the presence of an appropriate feedstock the atoms of the feedstock self-assemble on the ordered features of the substrate to produce an ordered array of nano-features having non-random alignment and size distribution, with the size, shape and pattern of self-assembled nano-array features grown on the substrate being adapted such that molecules within a specified size range can be separated. Note also paragraph [0051] on page 6 of this patent document, together with Fig. 5, showing sieve body 44 including a cap layer 66 which makes intimate contact with the array sieve 54.

Noca, et al., either alone or in combination with the teachings of the other references applied therewith, would have neither disclosed nor would have suggested the presently claimed subject matter, including the aspect ratio, of micro pillars, with advantages of the present invention in light thereof.

Moreover, it is respectfully submitted that even taking the additional teachings of Noca, et al. and/or Agrawal, et al. together with the teachings of the two Austin, et al. references and Wang, et al., such overall teachings of these references provide no reason nor suggestion for combining teachings of Wang, et al., of carbon nanotubes which are individual and separate, with the teachings of, e.g., Austin, et al., as applied by the Examiner.

In view of the foregoing comments and amendments, and, moreover, in view of the concurrently filed RCE Transmittal, entry of the present amendments, and reconsideration and allowance of all claims being considered on the merits in the above-identified application, are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (No. 520.43241X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

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